



1982

Overview of Sand and Gravel Resources of Kentucky

Preston McGrain
University of Kentucky

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KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY, LEXINGTON
Donald C. Haney, Director and State Geologist

OVERVIEW OF SAND AND GRAVEL RESOURCES OF KENTUCKY

Preston McGrain

REPORT OF INVESTIGATIONS 1
SERIES XI, 1982

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OVERVIEW OF SAND AND GRAVEL RESOURCES OF KENTUCKY

Preston McGrain

ABSTRACT

Sand and gravel represent Kentucky's second-most important source of mineral construction material, being exceeded only by limestone. However, deposits which meet most requirements and specifications for aggregates are not evenly distributed. This report is an overview of the sand and gravel resources of Kentucky, summarizing data gathered from literature search and personal observations.

Principal production of sand and gravel in Kentucky is concentrated in the channels and valleys of the Ohio and Mississippi Rivers. Approximately two-thirds of Kentucky's current production is derived from floating dredge operations in the Ohio River itself and glacial outwash deposits of Wisconsin age along its valley.

Extensive deposits of fresh-water chert gravels and unconsolidated, fine-grained, quartzose, marine sands are present in the Mississippi Embayment area of western Kentucky, but because of their gradation and lithologic characteristics, they are used relatively little at this time.

A few, small, high-level terrace sand and gravel deposits are present on uplands adjacent to or relatively near some of Kentucky's major waterways. These represent remnants of ancient stream deposits and generally are of small areal extent and variable composition. Consequently they have limited commercial significance.

Highly weathered or poorly indurated conglomerates and sandstones of Pennsylvanian and Mississippian ages have been exploited locally for miscellaneous construction and industrial purposes when conventional deposits were not available. Poor gradation and deleterious accessory minerals have limited their use.

On the basis of current use, most Kentucky deposits are classified as construction sands and gravels. Some deposits, however, contain a sufficiently high silica content to classify them as industrial sands and gravels; they are used on a limited scale in foundry, metallurgical, and miscellaneous industries.

INTRODUCTION

In terms of both value and volume, sand and gravel constitute the second-most important source of mineral construction raw material in Kentucky, being exceeded only by limestone. Production has increased markedly in recent years, reflecting substantial growth in Kentucky's construction industry. According to preliminary compilations by the U. S. Bureau of Mines, sand and gravel production in the State in 1979 exceeded 11 million tons with an estimated value of \$23 million (Fig. 1). The total tonnage and value of crushed limestone exceeds that for sand and gravel by a ratio of more than three to one.

This report is an overview of the sand and gravel resources in Kentucky. It provides a guide for those concerned with exploring and developing mineral aggregates and a base for future detailed studies characterizing specific deposits.

Sand and gravel are important ingredients in many construction activities such as highways, bridges, dams, office and residential buildings, airport runways, schools, sidewalks, driveways, and the like. The number of people engaged in the production of sand and gravel is not

large but the products made from these materials affect almost every facet of the construction industry. In Kentucky, largest tonnages have been used for cement- and bituminous-concrete aggregates, fill, concrete products, and road base.

Naturally occurring sands and gravels are unconsolidated or poorly consolidated granular materials resulting from the natural disintegration of rocks. In their marketable form the particles should be hard; dense; clean; free from clay and clay-size material, organic matter, and chemical salts; and capable of being well bound together with cementing agents such as asphalt and portland cement. Gravels containing coal, shale, soft chert or limestone, sandstone, or siltstone are usually of little value in road construction.

In the past, the geologic literature of Kentucky has given relatively little specific attention to the State's sand and gravel deposits as sources of construction raw materials. It was apparently assumed that aggregates were abundantly available from streams draining regions of sandstones and chert-bearing formations and along streams that drained south and west from Pleistocene ice sheets, or from the abundant limestone deposits from for-

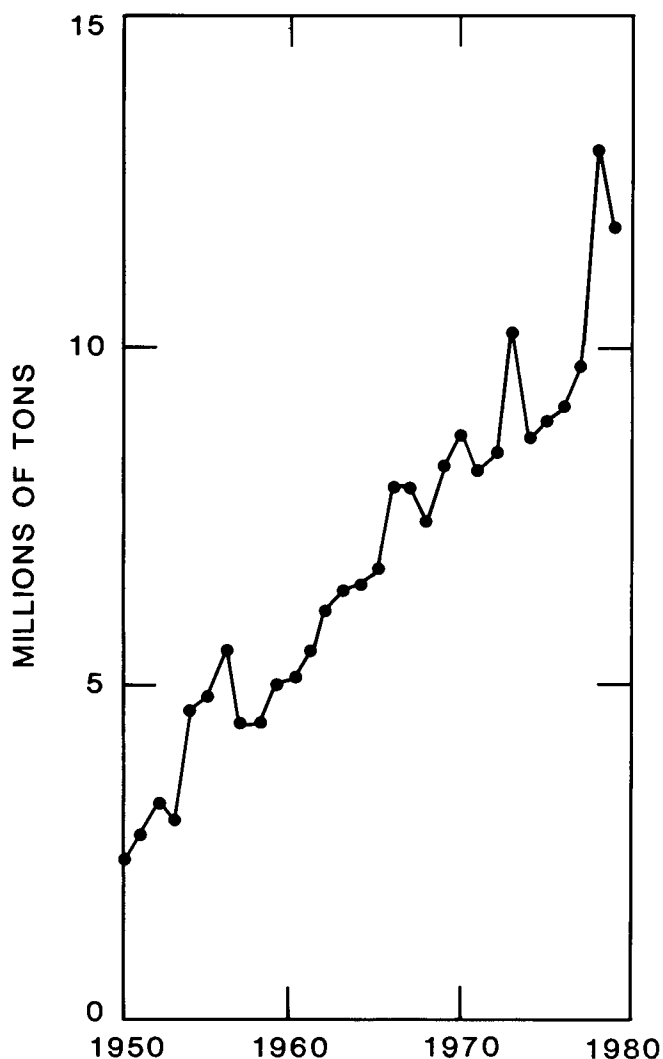


Figure 1. Graph of sand and gravel production in Kentucky, 1950-1979. Production reflects construction trends in the Commonwealth. Data compiled from U. S. Bureau of Mines reports.

mations ranging in age from Ordovician to Pennsylvanian. However, a considerable amount of information relative to the character or occurrence of sand and gravel in various parts of the State can be gleaned from a perusal of a variety of geological reports, many of which are cited elsewhere in this text.

Industrial sands, which were used for molding, casting, and glass, received special attention from Richardson in 1920 and 1927. Richardson's report on the molding sands of Kentucky (1927) identified 103 active and inactive pits and operations in 19 counties, most of which were in the vicinity of larger industrial areas of that time. They involved fluvial deposits, river sands, glacial deposits, and decomposing or poorly cemented sandstones of Mississippian age. It should be noted that since the 1927 report, many of these sites, which also included po-

tential construction materials, have been occupied by urban and industrial development and most pits described in the older literature are no longer operated. Investigations during the 1950's were primarily for industrial sands (McGrain 1952, 1956; McGrain and Crawford, 1959a, 1959b).

Increased traffic, heavier loads, and the application of bituminous and cement concrete have caused progressively rigid specifications to be imposed for road aggregates. Consequently, a commercial deposit of yesteryear may not pass wear and soundness tests required for a modern highway and be relegated to use for fill, berms, or secondary roads at best.

The potential of a sand and gravel deposit as a resource depends upon depth to and thickness and extent of the deposit; thickness and variability of overburden; particle-size distribution; physical properties; rock types; impurities; distance from market; mode of transportation; cost of land; and zoning regulations. Because construction sands and gravels are high-bulk, low-cost mineral commodities, they should be produced as close to points of use as possible.

Particle size is the main distinguishing characteristic. For commercial use in Kentucky, sand, in general, must pass a 3/8-inch mesh standard sieve (openings 0.375 inch or 9.5 mm) and be retained on a No. 200-mesh sieve (openings 0.0029 inch or 0.075 mm). Gravels, in general, must pass a 4-inch screen and be retained on a No. 4-mesh sieve (openings 0.187 inch or 4.75 mm). The gradation specifications between these ranges will vary, depending upon the end use.

Specifications for sand and gravel to be used in public road and bridge construction in Kentucky are determined by the Kentucky Department of Transportation, Frankfort, Kentucky (Kentucky Department of Transportation, 1979, p. 599-610). These specifications prescribe maximum allowable amounts of deleterious materials, size gradations, wear, soundness, and other physical properties for a variety of different uses.

Special thanks are due and are herewith tendered to Mr. David L. Arnall, Kentucky Department of Transportation (now retired), for his counsel during this investigation and for reviewing the manuscript.

DISTRIBUTION AND GEOLOGIC CONTROLS

Sand and gravel deposits are found in and along many of the State's streams and at scattered upland sites where they have been deposited by prehistoric rivers, but deposits of commercial quality are not evenly distributed. They are found primarily adjacent to and in the beds of the Ohio and Mississippi Rivers, their presence being associated with the geologic history of the central United States when much of the north-central region was cov-

ered by glaciers.

The geology of Kentucky, insofar as it is of interest to the producer or user of construction materials, has two important features. First, unlike many sand- and gravel-producing states to the north, very little of Kentucky was glaciated. However, stream valleys and flood plains along the State's northern and western borders, particularly the Ohio River, received copious quantities of glacial-derived outwash materials. Second, the State is almost completely underlain by sedimentary rocks, ranging in age from Ordovician to Recent, which contain many carbonate-rock formations (Fig. 2). In a broad sense, Kentucky has two principal sources of construction aggregates. The valleys of the Ohio and Mississippi Rivers, which form the northern and western boundaries of the Commonwealth, are the principal sources of sand and gravel, but crushed limestone is the principal construction material in most of the remainder of the State.

Sand and gravel deposits along the valley of the Ohio River were formed when several closely related movements of a continental glacier pushed across the north-central states toward the area now known as Kentucky. As the ice sheet alternately pushed its way southward and melted back, vast amounts of meltwater laden with rock debris, derived from geologic formations in northern states and Canada, flowed from the front of it. Glacial meltwaters transported the sands and gravels, together with fragments of local and native stone, to their present locations as valley-fill materials. These are supplemented by modern stream deposits such as sand and gravel bars and flood-plain deposits. The greatest quantities and the

coarsest materials appear to have been deposited downstream from the Greater Cincinnati area, at points below the mouths of the south-flowing Little Miami, Miami, and Whitewater Rivers.

Since the Ohio and Mississippi Rivers are used heavily by barge traffic, a navigable waterway must be maintained. Thus, the exploitation of sand and gravel from the channel not only supplies a need of the construction industry but also assists in maintaining an important transportation route.

Extensive deposits of fresh-water chert gravels and unconsolidated, fine-grained, quartzose, marine sands are present in the Mississippi Embayment area of western Kentucky, but because of their gradation and lithologic characteristics they do not make major contributions to the aggregate industry of Kentucky at this time.

A few, small, high-level terrace gravel deposits are present on uplands adjacent to or relatively near some of Kentucky's major waterways. These represent remnants of ancient stream deposits and are usually of variable composition and small areal extent.

Highly weathered or poorly indurated conglomerates and sandstones of Pennsylvanian and Mississippian ages have been exploited locally in both eastern and western Kentucky for miscellaneous construction and industrial purposes when conventional deposits were not available. Poor gradation and deleterious accessory minerals have limited their use.

Recently published geologic quadrangle maps, scale 1:24,000, show the outcrop areas of the gravel- and sand-bearing formations and the locations of many of the

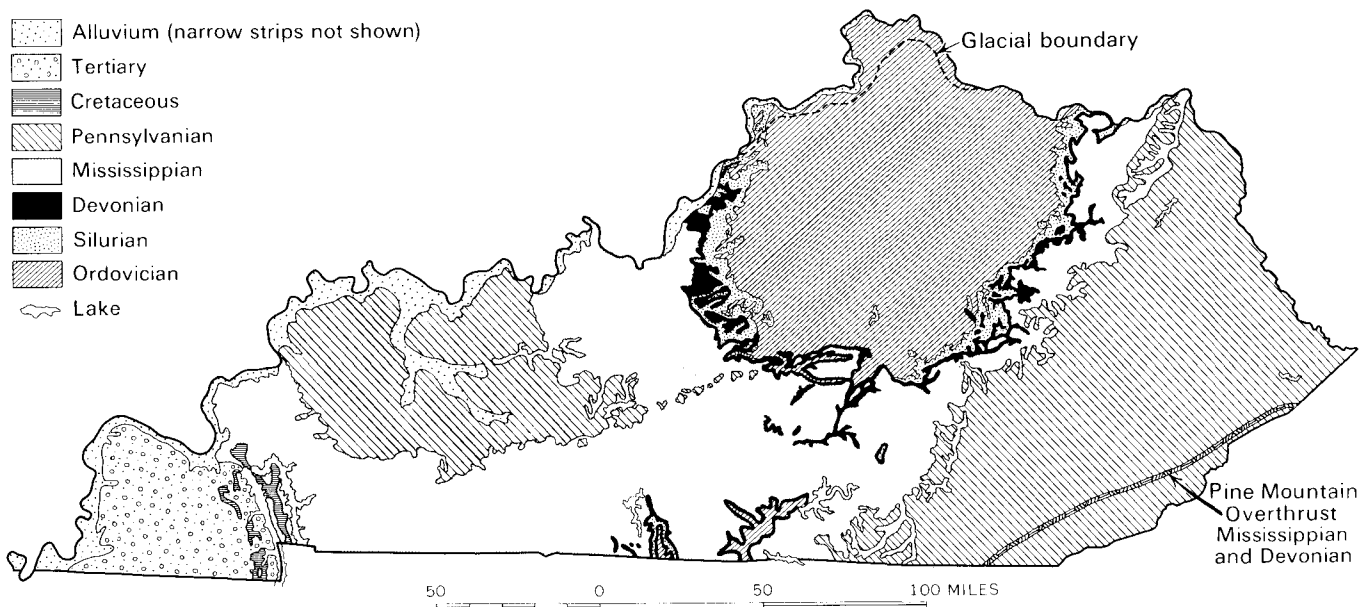


Figure 2. Generalized geologic map of Kentucky. The valleys of the Ohio and Mississippi Rivers, which form the northern and western boundaries of the State, are the principal sources of sand and gravel.



Figure 5. Poorly sorted sand and gravel in Wisconsin glacial outwash near Petersburg, Boone County. The gravels are crushed, washed, and sized for concrete aggregate and other construction purposes.

logic maps, which are available for the whole State, a geologist can determine areas which might be underlain by potentially commercial sands and gravels. The outwash deposits are mapped variously as Wisconsin outwash, terrace deposits, fluvial deposits, older alluvium, and alluvium. (These terrace deposits are not to be confused with terrace deposits of high-level brown chert gravel that

locally cap some of the hills and ridges along the Ohio River and some of Kentucky's other major streams.) Weathered silt and fine sand, generally 5 to 20 feet thick, cap the glacial outwash deposits throughout the valley. Eolian and natural-levee deposits are sometimes superimposed on the outwash deposits and modify the topography of the valley floor. Locally, natural levee deposits

Table 1. — Published Lithologic Characterization of Gravels along the Ohio River Valley, Listed from East to West, Showing Percentage of Rock Types.

LOCATION AND REFERENCE	CARBONATE ROCKS	CHERT	CRYSTALLINE ROCKS	QUARTZ	SANDSTONE AND SILTSTONE	SHALE	COAL
Vanceburg Quadrangle Morris and Pierce, 1967	35	15	10	5	25	5	5
Manchester Quadrangle Peck and Pierce, 1966	25	18	11	3	22	17	4
Maysville East Quadrangle Weiss and other, 1972	10	35	13	7	25	5	5
Maysville West Quadrangle Gibbons and Weiss, 1972	10	35	13	7	25	5	5
Moscow Quadrangle Luft and others, 1973	30	10	27	4	29		
Hancock County McGrain and others, 1970	35	3	55	1	6		

have been sources of sand for subfoundation fill.

Best opportunities to view the deposits are in active or inactive pits. Further clues to subsurface deposits may be found in well-drilling logs, foundation borings for bridges and dams, and various geological reports. For example, a regional ground-water report and the series of hydrologic investigation atlases prepared by the U. S. Geological Survey (Gallaher, 1963a-c, 1964a-d; Price, 1963, 1964a-f; Walker, 1957) covering the Kentucky portion of the Ohio River Valley contain generalized logs and cross sections depicting the gross characteristics of the valley-fill sediments. Figure 6 is an example of the type of data included in the hydrologic investigations atlases.

A sand and gravel deposit normally needs 25 to 40 percent gravel to be economically significant and to meet customer needs. In general, a land-based deposit should not have more than 20 feet of overburden. However, along the Ohio River Valley, availability and costs of land are frequently the current dominant factors in selecting a site.

Mississippi River Valley

Like the Ohio River, the principal supplies of sand and

gravel from the Mississippi River Valley are obtained from bars and other deposits in the channel itself by floating operations. Storage yards are located at Columbus and Hickman.

Olive (1976) described gravel dredged from the Mississippi River about 2 miles downstream from Columbus, Hickman County, as mostly subangular to subrounded chert fragments as long as 6 inches and pebbles of quartzite, pink granite, sandstone, gneiss, and slate. He (Olive, 1976) also reported that sand occurs at the surface in scattered areas of the Mississippi flood plain but, due to frequent flooding, the location and configuration of the surficial deposits may change from year to year.

Gravel in alluvial deposits along the Mississippi River flood plain is commonly cherty, some closely resembling the continental deposits that border the stream. Drill-hole data indicate the alluvium may attain thicknesses in excess of 100 feet (Baker, 1963). Sand is olive gray to yellowish tan, very fine to very coarse, angular to well rounded, composed dominantly of quartz and chert, but locally may contain mica, coal, and grains of igneous and metamorphic rocks. Silt and clay are the most common impurities.

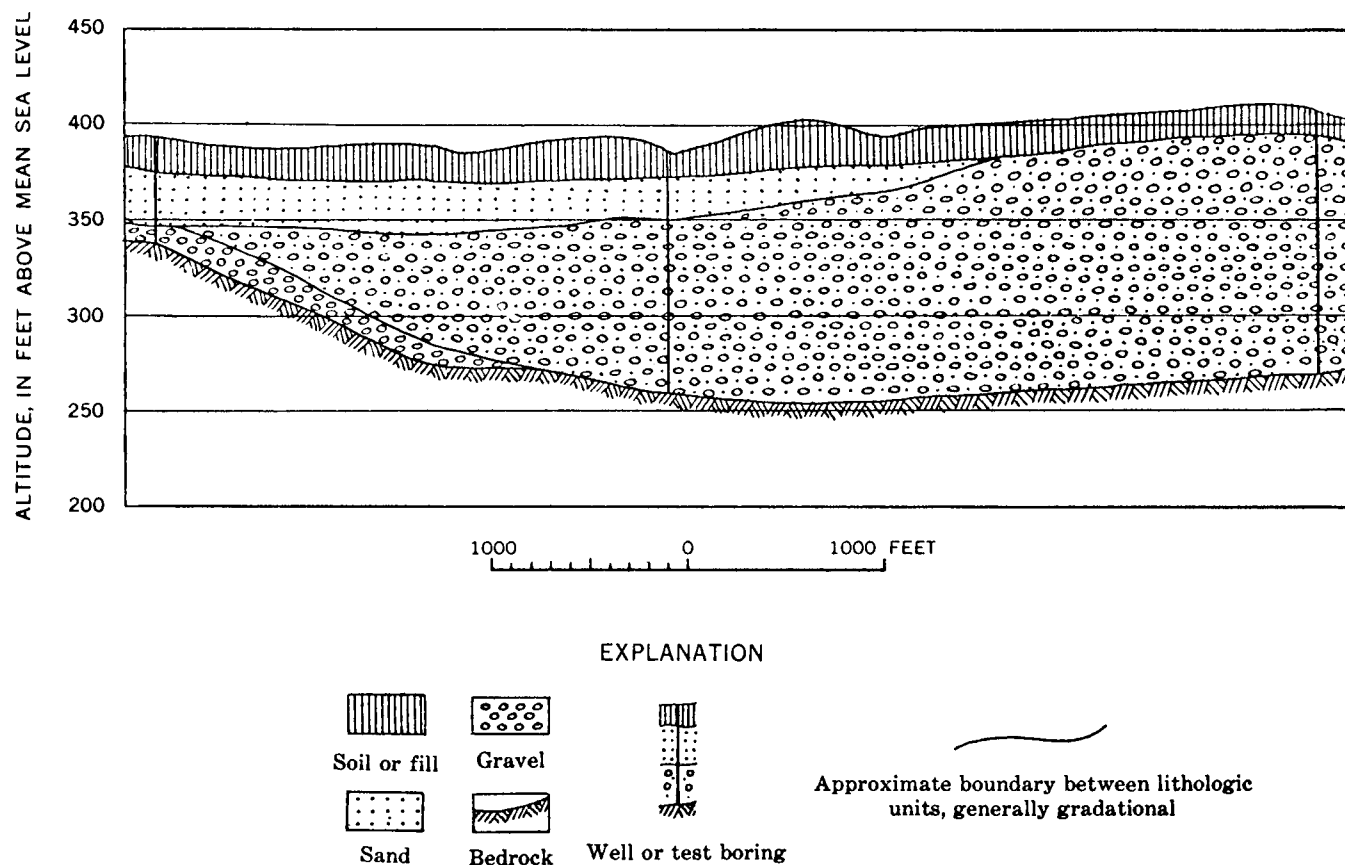


Figure 6. Geologic section across the Ohio River Valley in Hancock County showing sand and gravel deposits. After Gallaher, 1963a.

Continental Deposits

Deposits of brown Plio-Pleistocene gravels (also called "Lafayette gravel" and referred to on most geologic quadrangle maps as "continental deposits") blanket most of the upland area of the eight-county Jackson Purchase region of extreme western Kentucky, cap hills and ridges of the adjacent Mississippian Plateau, and occur as small, intermittent high-level or high-terrace deposits on upland surfaces near some of Kentucky's larger rivers. Because of their color, they are commonly referred to as "brown gravels." The deposits in and adjacent to the Jackson Purchase region are considered to be remnants of coalescing alluvial fans related to the ancestral Mississippi, Ohio, Tennessee, and Cumberland Rivers and were deposited in the uppermost portion of the Mississippi Embayment (Potter, 1955).

The continental gravels consist largely of chert pebbles from 1/2 to 1 inch in diameter (Fig. 7), but may contain quartz or quartzite and silicified fossils. Calcareous materials are generally absent. Most pebbles are coated with a thin layer of limonite. A local concentration of limonite will cement the pebbles together into a conglomerate, sometimes forming a resistant bed or ledge which may

pose problems in recovering gravel from pits. Sand of quartz or chert is a common constituent of the continental deposits, occurring either as a matrix in the gravel or as distinct beds (Fig. 8). It, too, is usually iron-stained. Clay may occur disseminated in the matrix, as pellets in the sand, or, more rarely, as distinct lenses. A covering of loess, usually 5 to 30 feet thick, mantles much of the continental deposits in the embayment area. Greatest thicknesses of loess, 25 to 75 feet, are present along and near the bluffs of the Mississippi River.

The limonite coating is more prevalent towards the eastern part of the region, while from the western part of Graves County to the Mississippi River the gravel has less iron and the pebbles are smaller (Roberts and Gildersleeve, 1950, p. 71). Exceptions have been noted in the Ohio River bluffs north of Wickliffe. Where lighter colored gravels are encountered, smaller size and less rounding, flattening, and iron staining distinguish them from the Tuscaloosa gravels (Cretaceous) of the Tennessee River-Kentucky Lake area.

According to Potter (1955), particles greater than 2 millimeters constitute 65 percent by weight of the gravel and consist almost exclusively of chert, vein quartz, and



Figure 7. Brown chert gravel in continental deposits in central Calloway County.



Figure 8. Stratified brown chert gravel and quartz and chert sand in continental deposits near Briensburg, Marshall County.

metamorphic quartz. Chert constitutes 86 percent of the particles exceeding 2 millimeters, and quartz constitutes 14 percent. Quartz averages approximately 88 percent of the sand fraction and chert averages 9 percent.

The presence of clay and lightweight (less than 2.35 specific gravity) chert in the continental deposits of the Jackson Purchase region may render them unsatisfactory for use as a concrete aggregate, but the gravel has found wide use as aggregate for secondary roads, private roads and drives, berms, fill material, preparation of building sites, base construction for paved highways, and similar construction projects, as can be attested by the hundreds of pits that have been active at one time or another in the eight-county area. Washed and sized gravel is sometimes used for roofing gravel and mulch.

Since gravels with higher silt and clay contents pack better and are more suited for road metal than low-silt-and-clay gravel which is characterized by excessive loose particles, the demand may be greater locally for the materials containing finer grain sizes. Finch (1968) observed that gravels above the 440-foot contour in portions of McCracken County contained more silt and clay than those below.

In a recent publication, Olive (1980) indicated that the largest and most easily accessible sources of gravels are in the eastern part of the Jackson Purchase region where

the continental deposits are thickest and the overlying loess is generally less than 15 feet thick.

Most of the pits in the brown gravels operate intermittently, or on an "on-call" basis, producing "pit- or mine-run" material on demand rather than processing and stockpiling as do most other producers (Fig. 9). Mobile equipment is used in such operations. Thus an active pit one day may be inactive the next and *vice versa*. In a few instances, however, washing and sizing equipment has been installed at the pit, but this is the exception.

Gravels derived primarily from the continental deposits are commonly found in the streams within and bordering the Jackson Purchase region but are not often exploited because gravels at higher elevations are so abundant and more favorably situated for recovery. Red-brown gravel and sand have been recovered by dredge operations from the Tennessee River near Paducah but the high content of deleterious (lightweight) chert has rendered the gravel unsatisfactory for most current specifications for cement concrete aggregate. Gravel from this source has been used for roofing gravel and purposes other than cement concrete (McGrain, 1978). Color preference by consumers and a better natural size gradation has made the predominantly gray sand from the Ohio River generally more marketable than red-brown sand from the Tennessee River.



Figure 9. An active gravel pit in continental deposits in southern McCracken County. Most of the pits in continental deposits produce a mine-run material that is used without sizing or washing for secondary roads, drives, berms, and fill. After McGrain, 1978, Fig. 8.

Tuscaloosa Gravel

The Tuscaloosa Formation, the basal unit of the Cretaceous sediments on the eastern edge of the Mississippi Embayment region of western Kentucky, consists largely of well-rounded, water-worn, nonmarine pebbles and boulders derived from Mississippian and Devonian cherts. It rests on eroded Paleozoic rocks and occurs in discontinuous patches in the Cumberland and Tennessee Rivers areas of Trigg, Lyon, Livingston, Marshall, and Calloway Counties. The configuration of the bedrock surface on which the Tuscaloosa rests suggests that it was deposited in a narrow north-trending trough that probably represents an estuary or stream valley that opened into an arm of the Gulf of Mexico (Olive, 1972, p. 4).

Tuscaloosa gravels are characteristically light gray, light tan, or off white in color, a marked contrast to the reddish and brown, ferruginous continental deposits. Large tonnages are present but much of the outcrop area lies in the Federally administered Land Between The Lakes recreation area. Exposures in excess of 50 feet in thickness are present near Kentucky Dam.

Gravels, normally 1 to 4 inches in diameter, range in size from a fraction of an inch to as much as 8 or 10 inches, but average less than 2 inches (Fig. 10). Chert, commonly porous, is the predominant lithology, but pebbles of limestone, orthoquartzite, and silicified fossils may be present also. The matrix is mostly light-gray silt and tripolitic earth. There is little evidence of

stratification, although lenses of tripolitic earth have been observed.

Gravels from the Tuscaloosa were once used for roads, railroad ballast, and other construction and building purposes in several western Kentucky counties. The largest pits were along and near the Tennessee River in the vicinity of Grand Rivers, Livingston County. But because of the presence of deleterious chert it is not currently used in any quantity in concrete aggregate, being replaced by crushed limestone. Attempts have also been made to use the Tuscaloosa for fluxing silica but the results have not always been satisfactory.

Embayment Sands

Other potential sources of sand in the Jackson Purchase or Mississippi Embayment counties of western Kentucky are found in formations of Cretaceous and Eocene ages, particularly the McNairy (Cretaceous) in Calloway and Marshall Counties and Claiborne (Eocene) of the central and western counties of the region.

The sands vary in color, being red, tan, yellow, and white. They range from very fine to coarse, are locally pebbly, with finer gradations predominating (Figs. 11 and 12). Grains are angular to subrounded. Quartz is the predominant mineral, commonly constituting more than 90 percent of the deposit. Clay may be present, either as a lense or as matrix material in the sand. Minor amounts of heavy minerals are present in the lower part of the



Figure 10. Tuscaloosa gravel near Grand Rivers, Livingston County. Gravel is predominantly chert; the matrix is mostly silt and tripolitic earth.

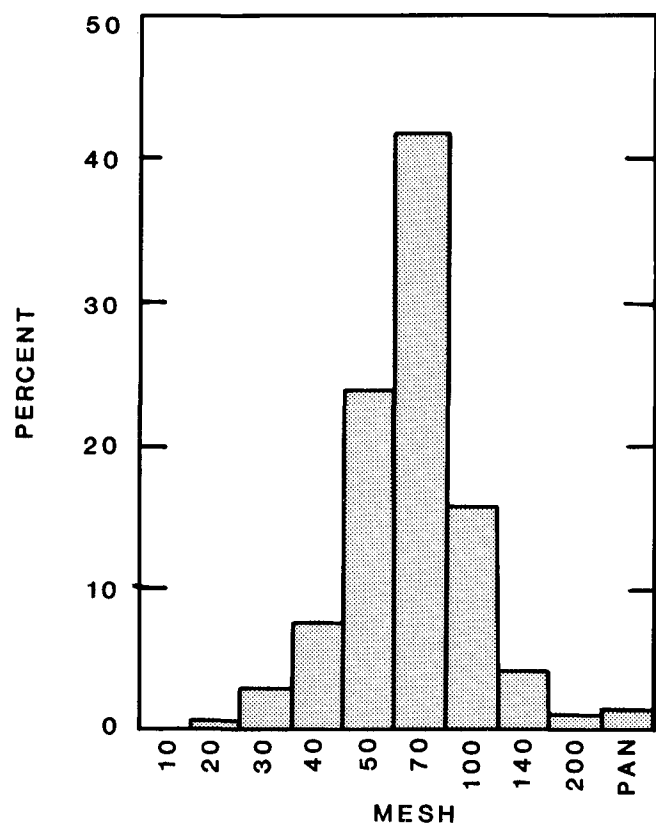


Figure 11. Grain-size distribution of unprocessed McNairy (Cretaceous) sand from Calloway County. This sand has been processed and used in foundry, construction, metallurgical, and ceramic industries. Adapted from McGrain, 1968, p. 20.

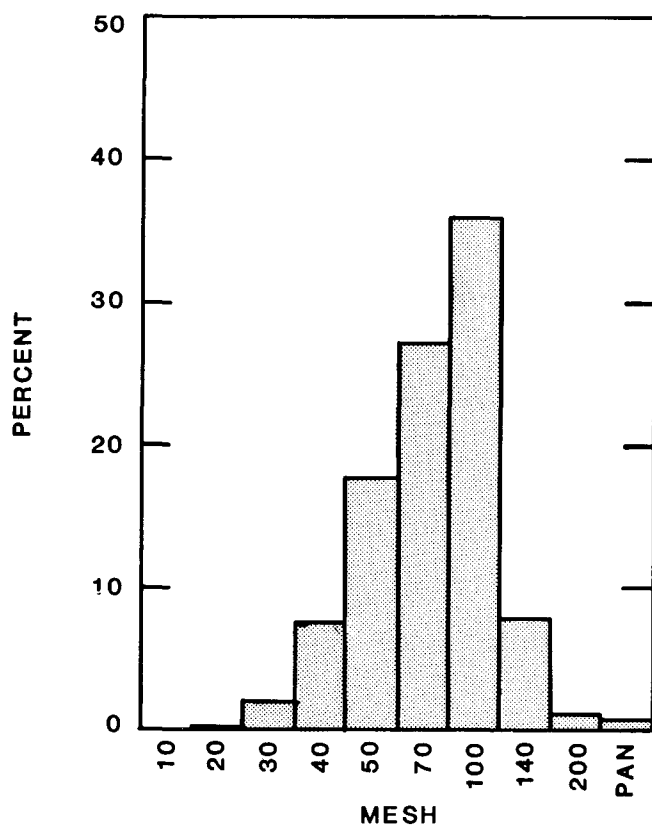


Figure 12. Grain-size distribution of unprocessed Claiborne (Eocene) sand from McCracken County. The sand has been used for road fill and preparation of building sites. Adapted from McGrain, 1978, Fig. 10.

McNairy. Because of their high SiO_2 content, some deposits might be classified as industrial silica.

Locally, there are deposits which might be suitable for use in foundries and metallurgical industries, for making molds in which metals are cast or that form cores for hollow parts of casings, for abrasives, for road and other sub-foundation fill, for the preparation of building sites, for plaster and mortar, and other miscellaneous purposes (McGrain, 1968, 1970, 1978; McGrain and Crawford, 1959).

Most of the pits in the embayment sands of western Kentucky have operated on an on-call basis, supplying pit-run or unprocessed sand for fill and preparation of building sites. An exception is in Calloway County. There, a company mines, washes, classifies, and dries sand from the McNairy Formation for foundry, construction, coated sand, sand blasting, and miscellaneous purposes (Fig. 13).

Miscellaneous Deposits

Unconsolidated sand and gravel deposits associated with both present and ancient streams are found in a

number of localities within the interior of the Commonwealth. Although used locally, primarily for secondary roads and fill, neither the size of the deposits nor the quality of materials classify them as major sources of construction aggregates.

Recent alluvial gravels are present in a number of streams in the interior of Kentucky, such as Green River, Rolling Fork, Big Sandy River, and Triplett Creek to name a few. The composition and nature of the deposits are varied, reflecting the diversity of rock types through which the streams flow (Figs. 14, 15, and 16). Cherts and subangular fragments of siltstone are common constituents of stream gravels, and because of this are generally excluded from use in concrete aggregate. However, they have been used in many localities for fill and for surface material for public and private secondary or light-duty roads. Deposits at any one locality are not large but supplies are replenished as floods bring rock debris from headwater areas. Attempts to obtain large commercial supplies on the lower reaches of Barren, Green, and Kentucky Rivers have been generally unsuccessful.

The Irvine Formation (Tertiary) consists of sand, silt,



Figure 13. Pit in McNairy sand in southeastern Calloway County. Photograph courtesy Murray Silica Sand Company.



Figure 14. Stream gravel along Buck Creek, southern Lincoln County. The gravel consists mainly of chert, geodes, and siltstone fragments derived from rocks of Mississippian age. It is used locally for fill and for secondary or light-duty roads.



Figure 15. Stream gravel, Triplett Creek drainage basin, Rowan County. The gravel consists primarily of fragments of siltstone derived from the Borden Formation (Mississippian). Small tonnages are used locally for secondary roads and fill.



Figure 16. Slabby limestone gravel, Cabin Creek, northwestern Lewis County. According to Peck (1967), the limestone gravel has been crushed for use on secondary roads, and uncrushed stream gravel was used locally on farm roads. The gravel is derived principally from rocks of Ordovician age.

clay, and gravel which was deposited along the ancient route of the Kentucky River. Deposits are patchy, range in thickness from less than 5 to more than 75 feet, and occur 150 feet or more above the present stream. Thin, basal gravels, where present, contain quartz and chert pebbles, silicified fossils, and small geodes. The sand is very fine to medium grained, reddish brown, and mixed with silt and clay. The parts of the Irvine Formation which appear to offer the greatest potential for development are the sand deposits in the Palmer (Simmons, 1967) and Panola (Greene, 1968) Quadrangles area of Estill and Madison Counties, if satisfactory gradations can be located.

Geologic quadrangle maps also have indicated the presence of high-level or terrace deposits of varied lithologies in the vicinity of the Ohio and Licking Rivers. These are generally quite small, commonly contain deleterious chert, and have had only limited, local use.

Deposits of quartz sand and gravel of variable thicknesses are present over fairly large areas in northeastern Hart and southern Larue Counties. They have been variously interpreted as weathered and slumped or reworked

conglomerates and sandstones of Early Pennsylvanian and Late Mississippian ages (Figs. 17 and 18). The area of greatest exploitation has been near the southern border of the Magnolia Quadrangle (Moore, 1975). Here, an unconsolidated fluvial deposit of quartz sand and rounded quartz pebbles and slumped and weathered conglomerate are washed and screened. The sand is used primarily for construction purposes. The pebbles, generally less than 1/2 inch in diameter, may be crushed for fine aggregate or find limited use as a decorative mulch around the base of buildings and plantings.

Deposits of weathered and slumped, very fine-grained quartz sand occur near the Hardin-Meade county line in the vicinity of Muldraugh. Derived from a channel-sandstone deposit of Late Mississippian age, these sands were once used for molding sand and the manufacture of glass products (Richardson, 1920, p. 92-94). The principal area of occurrence is now within the Fort Knox military reservation and is not considered to be available for commercial development.

Local deposits of a weathered and slumped, fine-grained, quartzose sandstone are present also in the vi-



Figure 17. Weathered and slumped(?) Pennsylvanian conglomeratic sandstone near Jonesville, northern Hart County.

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